PR-NET-OSM-032

PAD-MOUNTED SUBSTATIONS

OPERATIONAL SAFETY MANUAL - SECTION 4.8

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1 Introduction

1.1 A **Pad-mount Transformer** is a power transformer, with **High** and **Low Voltage connections**, of a containerised design. It is typically used in rural locations where space is a premium. It's small footprint and design characteristics requires a specific approach to operations.

1.2 This **Approved** procedure defines the operational requirements for **Pad-mount Transformers** used within **SSEN-D**.

2 Scope

2.1 This document relates to operational and work activities on **Pad-mount Transformers** under the **SSEN-D Operational Safety Rules (OSR).**

2.2 It applies to all persons employed by or working on behalf of **SSEN-D**.

2.3 This document applies to **Pad-mount Transformers** with conventional radial **High Voltage** cable terminations. The scope does not apply to **Pad-mount Transformers** for use with looped cable terminations or **High Voltage Load-Break Elbows**.

NOTE: **Pad-mount Transformers** with **High Voltage Load-Break Elbows** are not used in **SSEN-D**.

2.4 The scope of this document covers **Pad-mount Transformers** that connect directly to the **High Voltage System** or are connected via a **Switching** device, e.g. fuseswitch.

3 References

The documents detailed in Table 3.1 - Scottish and Southern Electricity Networks Documents, should be used in conjunction with this document.

Table 3.1 - Scottish and Southern Electricity Networks Documents

Reference	Title
PR-NET-OSM-006	SSEN Distribution Operational Safety Rules - Operational Safety Manual – Section 1.1
PR-NET-OSM-028	Switching Terminology and Approved Abbreviations - Operational Safety Manual - Section 4.4
PR-NET-OSM-026	High Voltage Switching and Earthing - Operational Safety Manual – Section 4.2
WI-NET-OSM-002	Personal Protective Equipment and Workwear for Live Environments
PR-PS-249	Replacement of Fuses on the HV Network Following Operation
N/A	SSEN SHE Handbook (Held in Safety, Health and Wellbeing SharePoint Site)

4 Definitions

4.1 The words printed in bold text within this document are either headings or definitions. Definitions used within this **Approved** Procedure are defined within the list presented immediately below, or within section 2 of the **Operational Safety Rules**.

4.2 **Load-Break Elbows**

High Voltage cable connectors that have a **Live Switching** capability

4.3 **Operational Safety Rules (OSR)**

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The **SSEN-D** Distribution set of rules, as read with related documents and procedures, that provide generic safe systems of work on the **System** therefore ensuring the health and safety of all who are liable to be affected by any **Danger** that might arise from the **System**.

4.4 **Pad-mount Transformer**

A compact, ground-mounted, cable-connected transformer typically comprising a conventional double-wound transformer, a **High Voltage** cable compartment, a **High Voltage** fusing arrangement and **Low Voltage** cable compartment

NOTE: **Pad-mount Transformers** are sometimes referred to as rural ground-mounted transformers.

5 General Responsibilities

5.1 **Persons** who are required to operate and undertake work on the **System**, **Shall** have a thorough understanding of the work and ensure on site risks are suitably assessed and appropriate control measures put in place before, during and after all activities.

5.2 Persons **Shall** ensure that, at all times during the work (or associated testing), **General Safety** arrangements are maintained and that other work areas are not adversely affected by the activities for which they are responsible.

6 Authorisation

6.1 Competence and authorisation certificates **Shall** be retained personally and be made available upon request.

6.2 Persons required to carry out **High Voltage Switching** at **Pad-mount Transformers Shall** receive specific training in the Operation of Pad-mount Substations.

6.3 The requirements of PR-NET-OSM-026 High Voltage Switching and Earthing - Operational Safety Manual – Section 4.2 **Shall** be complied with.

7 Personal Protective Equipment

7.1 Persons who are required to operate or work on Pad-mount Transformers **Shall** wear suitably **Approved** Personal Protective Equipment (PPE).

7.2 Where the **Pad-mount Transformer**, or immediate surrounding area, has warning labels, or labels that identify a particular hazard, the appropriate PPE **Shall** be worn to mitigate the hazard.

7.3 As a minimum, PPE Shall meet the requirements of WI-NET-OSM-002.

8 Pad-mount Transformer Description

8.1 A **Pad-mount Transformer** is a compact, ground-mounted, cable-connected transformer typically comprising a conventional double-wound transformer, a **High Voltage** cable compartment, a **High Voltage** fusing arrangement and separate **Low Voltage** cable compartment containing **Low Voltage** fusing arrangements.

8.2 **Pad-mount Transformers** are connected to **High Voltage** cable **Systems** either directly, as teed substations, or via controlling switchgear, typically **High Voltage** fuseswitch units, which are typically remote from the **Pad-mount Transformers**.

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8.3 **Pad-mount Transformers** have integral **High Voltage** fuses which are generally located in the **High Voltage** cable compartment or a separate compartment between the **High Voltage** cable compartment and the transformer main tank. The **High Voltage** fuses can either be air-insulated or oil-immersed.

8.4 The compartment housing the **High Voltage** cables and, where applicable, **High Voltage** fuses is accessed by a bolted metal cover plate. This access cover plate is padlocked on air insulated units (see Figure 8.1 for example, left picture is air insulated, right picture is oil insulated)

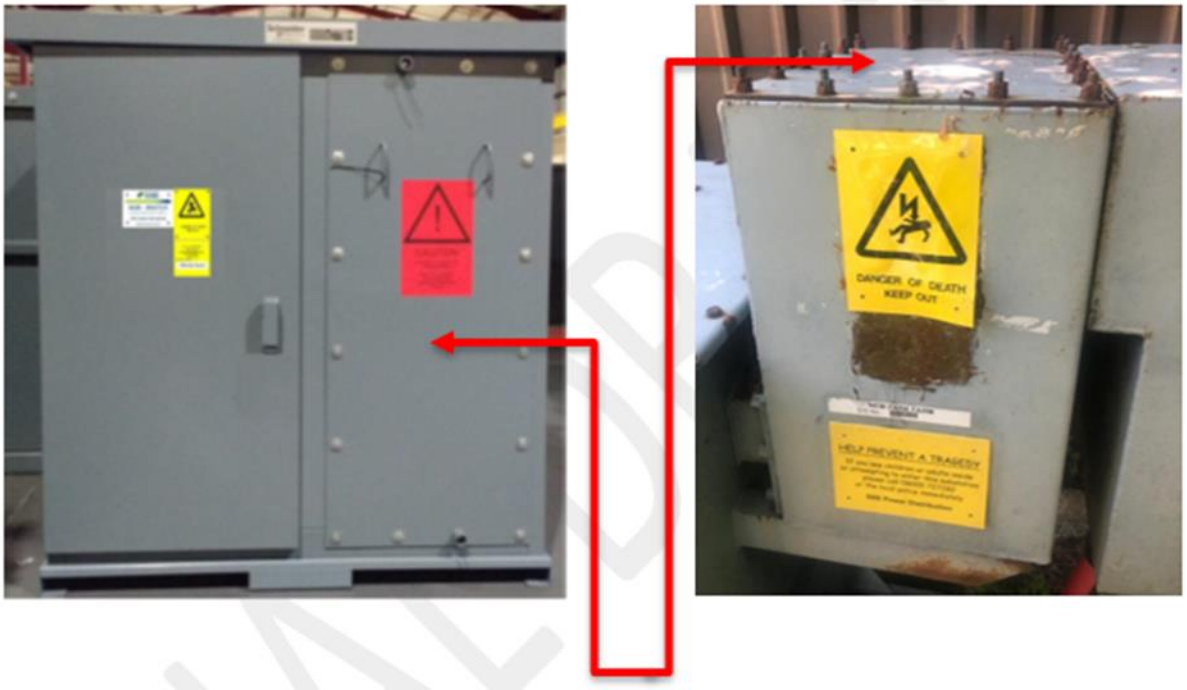

Figure 8.1 - High Voltage Compartment on Air Insulated and Oil Insulated Pad-mount

8.5 On newer **Pad-mount Transformers**, a Perspex insulated screen is fitted behind the **High Voltage** compartment cover. The Perspex insulated screen has test access holes for use of an **Approved** voltage testing device to prove Dead the **High Voltage** cable **Conductor** and/or **High Voltage** fuse terminals prior to carrying out work.

8.6 Operational notices that should be fitted to the **High Voltage** compartment cover(s) and Perspex insulated screen are shown respectively in Figure A.1 and Figure A.2 of Appendix A.

9 Operational Information

9.1 The **High Voltage** compartment cover(s) of a **Pad-mount Transformer Shall** not be opened or removed until:

- all **Low Voltage** fuses have been removed and the **Pad-mount Transformer** has been Isolated from any **Low Voltage** supply; and
- the **High Voltage** supply has been made **Dead**, Isolated and **Earthed**; and
- a **Permit-to-Work** or, where appropriate, a **Sanction-for-Test** has been issued

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9.2 Subject to the requirements of 9.1, the **High Voltage** compartment cover(s) **Shall** only be opened or removed under the **Personal Supervision** of a **Senior Authorised Person**.

9.3 Immediately after the **High Voltage** compartment cover is opened or removed, each **High Voltage** cable **Conductor Shall** be proved **Dead** by an **Approved** voltage testing device under the **Personal Supervision** of a **Senior Authorised Person**. **Approved** insulating gloves **Shall** be worn.

9.4 No person **Shall** approach within the **Safety Distance** of the **High Voltage Conductors**, or parts, unless an **Approved** insulated screen is in place that allows access for an **Approved** voltage testing device but prevents contact with any **Live Conductor** by a person.

NOTE: A Perspex cover is deemed to be an **Approved** insulated screen for the purpose of this **Approved** procedure.

9.5 Providing the **High Voltage** cable is **Earthed** and remains connected to the **Pad-mount Transformer** it is not necessary to apply an **Earth** in the **High Voltage** compartment.

10 Replacing High Voltage Fuses

10.1 General

10.1.1 The **High Voltage** fuses in **Pad-mount Transformers** can either be of the air-insulated or oil-immersed type. The appropriate procedure for their replacement **Shall** be followed depending upon the type of the **High Voltage** fuses.

10.1.2 **High Voltage** 'striker pin' fuses should be visually checked for operation.

NOTE: Striker pin fuses are installed with the trip pin end in the top holder of the fuse unit to provide additional visual indication that a fuse has operated. However, **Pad-mount Transformers** are not fitted with a trip bar or tripping arrangement(s).

10.1.3 Operation of only one **High Voltage** fuse will result in reduced volts on the **Low Voltage** side of the **Pad-mount Transformer** under these circumstances.

10.2 Oil-Immersed Fuses

10.2.1 Oil-immersed **High Voltage** fuses are typically located in a separate oil-filled compartment between the **High Voltage** cable compartment and the transformer main tank.

10.2.2 Access to the **High Voltage** fuses should be via a gasketed top access cover plate above the **High Voltage** fuses. The top access cover plate **Shall** not be removed until the requirements in 9.1 have been met.

10.2.3 **Approved** oil handling techniques **Shall** be followed to avoid contamination of the oil.

10.2.4 The following procedure **Shall** be followed:

1. Positively identify the correct substation.
2. Check the **Conductors** on the **Low Voltage** side of the **Pad-mount Transformer** using an **Approved** voltage testing device.
3. Contact the **Control Engineer** and report back the results / findings.
4. Write down the **Switching** instruction and read it back to the **Control Engineer** before undertaking the instructed **Switching** operation once permission is given.
5. Remove all **Low Voltage** fuses at the **Pad-mount Transformer** and apply point(s) of isolation.

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6. Carry out **High Voltage Switching**, apply point(s) of isolation and **Earths** as instructed by the **Control Engineer**.
7. Test the **Low Voltage Conductors** to prove **Dead**.
8. Issue a **Permit-to-Work** to change the **High Voltage** fuses.
9. Carefully remove the access cover plate on the **High Voltage** fuse compartment making sure that none of the gasket falls into the oil.
10. Test the incoming (top) side of each **High Voltage** fuse with an **Approved** voltage testing device to prove **Dead**.
11. Once proved **Dead**, lower the insulating oil level and change all **High Voltage** fuses.
12. Test the continuity of the replacement **High Voltage** fuses.
13. Replace the insulating oil to the correct level.
14. Carefully replace the access cover plate on the **High Voltage** fuse compartment cover securely, ensuring the integrity of the seal.
15. Cancel the **Permit-to-Work**.
16. Remove **Earths**, point(s) of isolation and carry out **High Voltage Switching** as instructed by the **Control Engineer** to make the **Pad-mount Transformer Live**.
17. Test the **Low Voltage Conductors** (transformer spills / terminals) to prove the Pad-mount Transformer is **Live**.
18. Remove the point(s) of isolation and replace the **Low Voltage** fuses at the **Pad-mount Transformer**.
19. Confirm times and details with the **Control Engineer**.

NOTE: The above procedure assumes the operation of a **High Voltage** fuse and the resulting **Switching** instructions are recorded in a **Switching** log book as opposed to a pre-checked and issued **Switching** schedule.

10.2.5 Steps “8” to “10” above **Shall** be carried out under the **Personal Supervision** of a **Senior Authorised Person** in accordance with Operational Safety Rule 5.4.4.

10.2.6 Reference should be made to procedure PR-PS-249 for specific non-operational aspects for the replacement of **High Voltage** fuses in **Pad-mount Transformers**.

10.3 Air-Insulated Fuses

10.3.1 Air-insulated **High Voltage** fuses are typically located in the **High Voltage** cable compartment.

10.3.2 Access to the **High Voltage** fuses should be via the **High Voltage** compartment cover(s) at the front of the **Pad-mount Transformer**. The **High Voltage** compartment cover(s) **Shall** not be removed until the requirements in 9.1 have been met.

10.3.3 The following procedure **Shall** be followed:

1. Positively identify the correct substation.
2. Check the **Conductors** (transformer spills / terminals) on the **Low Voltage** side of the **Pad-mount Transformer** using an **Approved** voltage testing device.
3. Contact the **Control Engineer** and report back the results / findings.
4. Write down the **Switching** instruction and read it back to the **Control Engineer** before undertaking the instructed **Switching** operation.

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5. Remove all **Low Voltage** fuses at the **Pad-mount Transformer** and apply isolation.
6. Carry out **High Voltage Switching**, apply isolation and **Earths** as instructed by the **Control Engineer**.
7. Test the **Low Voltage Conductors** (transformer spills / terminals) to prove **Dead**.
8. Issue a **Permit-to-Work** to change the **High Voltage** fuses.
9. Carefully remove the access cover of the **High Voltage** compartment.
10. Through the **Approved** (Perspex) insulated screen, test both ends of each **High Voltage** fuse with an **Approved** voltage testing device to prove **Dead**.
11. Once proved **Dead**, remove the **Approved** (Perspex) insulated screen and then change all **High Voltage** fuses.
12. Test the continuity of the replacement **High Voltage** fuses.
13. Replace the **Approved** (Perspex) insulated screen.
14. Carefully replace the access cover on the **High Voltage** compartment securely.
15. Cancel the **Permit-to-Work**.
16. Remove **Earths**, isolation and carry out **High Voltage Switching** as instructed by the **Control Engineer** to make the **Pad-mount Transformer Live**.
17. Test the **Low Voltage Conductors** (transformer spills / terminals) to prove the **Pad-mount Transformer** is **Live**.
18. Remove the isolation and replace the **Low Voltage** fuses at the **Pad-mount Transformer**.
19. Confirm times and details with the **Control Engineer.**

NOTE: The above procedure assumes the operation of a **High Voltage** fuse and the resulting **Switching** instructions are recorded in a **Switching** log book as opposed to a pre-checked and issued **Switching** schedule.

10.3.4 Steps “8” to “10” above **Shall** be carried out under the **Personal Supervision** of a **Senior Authorised Person** in accordance with **Operational Safety Rule** 5.4.4.

10.3.5 Reference should be made to procedure PR-PS-249 for specific non-operational aspects for the replacement of **High Voltage** fuses in **Pad-mount Transformers**.

11 Working in the High Voltage Compartment

11.1 Prior to carrying out work in the **High Voltage** compartment of a **Pad-mount Transformer** the requirements in 9.1 **Shall** be met, where work **Shall** be carried out under a **Permit-to-Work**.

11.2 Where the **High Voltage** compartment of a **Pad-mount Transformer** has an **Approved** (Perspex) insulated screen in place, that insulated screen **Shall** only be removed after each **High Voltage** cable **Conductor** has been proved **Dead** by an **Approved** voltage testing device under the **Personal Supervision** of a **Senior Authorised Person**.

11.3 On completion of work that insulated screen **Shall** be replaced before the **Permit-to-Work** is cancelled.

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12 Testing up to or in the High Voltage Compartment

12.1 Where it is necessary to isolate the **High Voltage** windings of the **Pad-mount Transformer** for the purposes of testing the **High Voltage** cable, the **High Voltage** fuses may be removed to provide such isolation subject to the requirements in 9.1 being met. In this case the **High Voltage** fuses may be removed under a **Sanction-for-Test** providing all **Circuit Main Earths** are applied.

NOTE: This constitutes minor work under the **Sanction-for-Test**.

12.2 Where the **High Voltage** compartment of a Pad-mount Transformer has an **Approved** (Perspex) insulated screen, that insulated screen should be used to screen the **High Voltage** cable **Conductors** which may become **Live** during testing.

12.3 Following testing, any **Circuit Main Earths** removed under the **Sanction-for-Test Shall** be replaced before replacing the **High Voltage** fuses of the **Pad-mount Transformer**.

12.4 All **High Voltage** fuses, **Approved** (Perspex) insulated screen and **High Voltage** compartment cover(s) of the **Pad-mount Transformer Shall** be replaced immediately after replacing the **High Voltage** fuses and any gear and tools **Shall** be removed before the associated **Sanction-for-Test** is cancelled.

13 Work in the Main Tank

13.1 Removal of the **High Voltage fuses Shall** not be used as a point of isolation for work in the main tank of the **Pad-mount Transformer**.

NOTE: There is no **Approved** means for applying an **Earth** at the High Voltage cable termination.

13.2 Prior to carrying out work in the main tank of a **Pad-mount Transformer**, the requirements in 9.1 **Shall** be met, where work **Shall** be carried out under a **Permit-to-Work**.

14 Changing Tap Position

14.1 The **Pad-mount Transformer** off-circuit tap selector switch **Shall** only be changed with the **Pad-mount Transformer Dead**.

14.2 The **Low Voltage Conductors** (transformer spills / terminals) **Shall** be tested for open-circuit volts using an **Approved** voltage testing device prior to and after making **Dead** to identify the **Pad-mount Transformer**.

15 Work in the LV Compartment

Prior to carrying out work in the **Low Voltage** compartment of a **Pad-mount Transformer**:

- the **High Voltage** cable **Shall,** where reasonably practicable, be made **Dead.**
- Any **Live Low Voltage Conductors Shall** be made Dead, or **Shall** be adequately screened to prevent **Danger**.

16 Revision History

No	Overview of Amendments	Previous Document	Revision	Authorisation
01	New document created	TBC	1.00	Richard Gough

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Appendix A Operational Notices

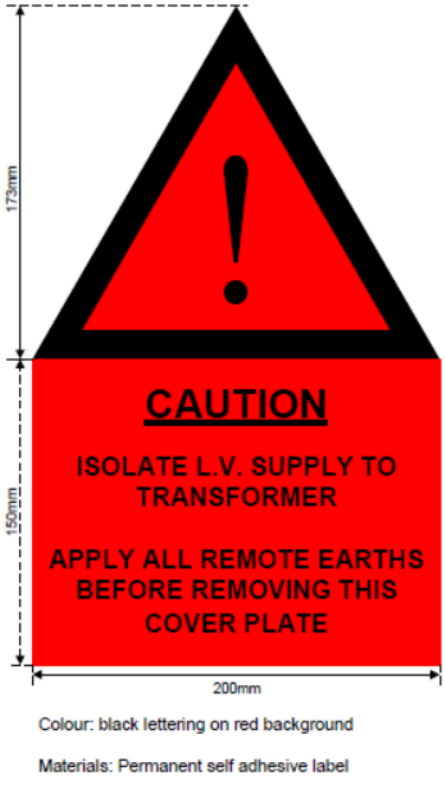

Figure A.1: Notice Fitted to High Voltage Compartment Access Cover

Figure A.2: Notice Fitted to Perspex Insulated Screen Behind High Voltage Compartment Access Cover

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